REMARKS

The present disclosure was filed on October 3, 2003 with 33 claims. A previous Response added claims 34-36. The Examiner issued a Restriction Requirement, and the Applicants in response elected the claims of Group I (i.e., claims 1-13, 25-34 and 36) and canceled the claims of Group II (i.e., claims 14-24 and 35). With the present response, Applicants amend claims 4, 7, 13, and 29 and add claims 37 and 38. The amendment to claim 4 is discussed below. The amendment to claim 7 is made for clarification and not patentability purposes and is supported, e.g., at paragraph 0036 and FIG. 4. The amendments to claims 13 and 29 are supported, e.g., at paragraphs 0049-0051 and 0054 and FIGS. 6 and 7 of Applicants' specification. New claim 37 is supported, e.g., at paragraph 32 and FIGS. 1, 5C, and 5D. New claim 38 is supported, e.g., at paragraphs 0038-0040. Consequently, claims 1-13, 25-34, and 36-38 are pending.

In the outstanding Office Action, the Examiner (1) objected to claim 4; (2) rejected claims 1, 2, 9, and 34 under 35 U.S.C. §102(b) as being anticipated by Ashby et al., U.S. Patent No. 5,463,649; (3) rejected claim 4 under 35 U.S.C. §103(a) as being unpatentable over Ashby; (4) rejected claims 3, 5-8, and 10 under 35 U.S.C. §103(a) as being unpatentable over Ashby in view of Nettleton et al. (Applied Optics, 20 May 2000); (5) rejected claims 11-13, 25-32, and 36 under 35 U.S.C. §103(a) as being unpatentable over Ashby in view of Polushkin et al., U.S. Patent No. 5,432,811; and (6) rejected claim 33 under 35 U.S.C. §103(a) as being unpatentable over Ashby and Polushkin and in further view of Nettleton.

Objection to Claim 4 in part (1)

Concerning the objection to claim 4, the Examiner asserted (paraphrasing) that claim 1 indicates that the cavity is formed by end faces and the reflecting coatings are formed on the end face, but that claim 4 appears to indicate that the reflecting coatings are not formed on the end faces but are instead deposited on mirrors external to the cavity. Applicants

disagree with this objection. Nonetheless, Applicants have modified claim 4 to read as follows: "The solid-state laser as in claim 1, wherein the end faces comprise resonator mirrors and where the at least partially reflecting coatings are deposited on the resonator mirrors ~~external to the resonant cavity~~." Such modification was not performed for patentability purposes. It is believed that the modification clarifies claim 4 and request the objection to claim 4 be withdrawn.

Rejections of claims 1, 2, 9, and 34 under 35 U.S.C. §102(b) in part (2)

In independent claim 1, Applicants claim a "laser resonator composite structure". Applicants state the following at paragraphs 0038-0041, where a composite structure 34 is described that becomes the laser resonator composite structure as recited in the claims:

> In Fig. 5B, the first and second structures 30, 32 are placed in optical contact along polished faces thereof to form a composite structure 34. The placing operation can be accomplished by a diffusion bonding process. Reference in this regard can be made, as examples, to U.S. Patent No.: 5,441,803, "Composites made from single crystal substances", H.E. Meissner; U.S. Patent No.: 5,846,638, "Composite optical and electro-optical devices", H.E. Meissner; and U.S. Patent No.: 5,852,622, "Solid state lasers with composite crystal or glass components", H.E. Meissner et al., or U.S. Patent No.: 6,548,176 "Hydroxide-Catalyzed Bonding", D. Gwo.
>
> As used herein "optically contacting" is taken to mean any technique for placing the gain medium 12 in a relation to the saturable absorber 14 such that there is substantial continuity of optical signals. Therefore, physical contact may not be required to achieve optical contact.
>
> Alternatively, an optical cement or epoxy may be used to bond the first and second structures together, or the two surfaces may be joined by other techniques. In a still further embodiment, the process steps shown in Figs. 5A and 5B may be replaced by instead providing a monolithic structure 34 that is co-doped with both Nd and Cr ions, as is known in the art.
>
> As a further alternative, forming the monolithic laser resonator structure starts with the optical gain material (e.g., Nd:YAG), and subsequent deposition of the saturable absorber material (e.g., Cr:YAG) onto the optical

gain material using liquid phase epitaxy. Further embodiments include the use of intermediate spacing materials, such as for example, undoped YAG.

Applicants also show such a laser resonator composite structure in FIG. 4 (reference number 16) and five such structures in FIG. 5D (reference number 34A).

It is noted that the laser resonator composite structures shown in FIG. 4 and FIG. 5D are not adjacent to and do not contain a substrate, as in Ashby (see, e.g., FIG. 2 and col. 3, lines 39-52 of Ashby). Thus, Applicants describe and claim a "free-standing" laser having a laser resonator composite structure that is not adjacent to and does not contain a substrate, unlike in Ashby. Additionally the Ashby patent requires the gain medium to be a waveguide structure and the disclosed invention does not have such a restriction.

Consequently, Applicants respectfully submit that independent claim 1 is patentable over Ashby. Because independent claim 1 is patentable over Ashby, dependent claims 2, 9, and 34 are also patentable for at least the reasons given with respect to independent claim 1.

New Claim 37

New claim 37 depends from independent claim 1 and recites the subject matter of "wherein the composite structure is formed as a monolithic block structure". Support for claim 37 is found, e.g., at paragraph 32 and FIGS. 1, 5C, and 5D of Applicants' specification. The recited subject matter in newly added claim 37 further distinguishes over Ashby, and Applicants respectfully submit that new claim 37 is patentable in conjunction with the subject matter of claim 1 and is patentable regardless of the patentability of independent claim 1.

Rejections of claims 3-8 and 10 under 35 U.S.C. §103(a) in parts (3) and (4)

Because independent claim 1 is patentable over Ashby, dependent claims 3-8 and 10 are also patentable for at least the reasons give above for independent claim 1. Further, Applicants in paragraph 0047 distinguish the Applicants' invention over Nettleton:

> The architecture of the laser 10 depicted in Fig. 4 differs from the above-noted monoblock laser design. For example, in the illustrated embodiment the laser gain medium 12 is preferably bonded to the passive Q-switch 14, and furthermore the laser 10 does not require a specialized alignment component, such as the ceramic laser pallet described in the above-referenced publication, entitled "Monoblock Laser for a Low-Cost, Eyesafe, Microlaser Range Finder", J.E. Nettleton et al., Applied Optics, Vol. 39, No. 15, pgs. 2428-2432, May 20, 2000, as well as US Patent Nos. 6,373,865 and 6,556,614.

Thus, Applicants respectfully submit that Nettleton does not disclose a "laser resonator composite structure" as recited in independent claim 1, from which dependent claims 3-8 and 10 depend. Therefore, Ashby, Nettleton, or their combination does not disclose this structure, and independent claim 1 and dependent claims 3-8 and 10 are patentable over the combination of Ashby and Nettleton.

New claim 38

New claim 38 recites the subject matter of "wherein the laser gain medium and passive Q-switch are bonded together" and is supported, e.g., at paragraphs 0038-0040. The subject matter recited in new claim 38 further distinguishes over Nettleton (and Ashby and their combination) and renders claim 38 patentable over the cited art.

Rejection of claims 11-13, 25-32, and 36 under 35 U.S.C. §103(a) in part (5)

Claims 11-13, 25-32, and 36 are directed to compensating for thermally induced aberrations in a laser and in particular in a laser resonator composite structure. As described above, Applicants respectfully submit that Ashby does not disclose a "laser resonator composite structure" as this term is defined by Applicants' specification and claims. Applicants also respectfully submit that Polushkin does not disclose a "laser resonator composite structure" as this term is defined by Applicants' specification and claims. Therefore, the combination of Ashby and Polushkin does not disclose a "laser resonator

composite structure", and claims 11-13, 25-32, and 36 are patentable over the combination of Ashby and Polushkin.

Moreover, for reasons given below, Applicants respectfully disagree with the Examiner's assertion that the apparatus in Polushkin inherently are thermal aberration compensation means. Applicants also respectfully disagree that a Porro prism may be considered a "tilt" (page 6, paragraph 1 of the outstanding Office Action, where it states the following: "This is by definition a Porro prism, and also may be considered a tilt"). It should be noted that Applicants are using the word "tilt" with the specific meaning as used, e.g., in optical aberration theory, where "tilt" is the lowest order optical aberration, and where defocus, astigmatism, and coma are higher-order terms.

Concerning whether tilt can be considered a Porro prism, Applicants show a single tilted end face 40 in FIG. 6 and a Porro prism 42 in FIG. 7 that can be used for thermal aberration compensation. Certainly, the tilted end face 40 and the Porro prism 42 look markedly different and there are no structures similar to the tilted end face 40 in Polushkin. Thus, even if the faceted ends and associated apparatus in Polushkin inherently are thermal aberration compensation means, using tilt for thermal aberration compensation is not taught by, suggested by, or inherent in Polushkin, as the disclosed faceted ends in Polushkin are not tilted faces as claimed herein and shown in FIG. 6. The claims that recite tilt (e.g., claims 12, 27, and 28) are therefore patentable over the combination of Ashby and Polushkin, as simple tilt leads to a far more manufacturable design than do faceted end faces. It should be noted that, regardless of whether "tilt" is defined by optical aberration theory or not, FIGS. 6 and 7 provide evidence that the terms "tilt" and "Porro prism" are different.

As for the Examiner's assertion that the apparatus in Polushkin inherently are thermal aberration compensation means, Applicants respectfully disagree. Although Applicants state that thermal aberration compensation can be performed through incorporation of a Porro prism, the Porro prisms in Polushkin are not taught as performing, are not suggested as performing, and do not perform thermal aberration compensation.

Those skilled in the art will realize that a Porro prism acts as a retro-reflector in one axis. In other words, along one axis, the Porro prism acts to retro-reflect; along another axis, the angle of reflection is twice the angle of incidence. That axis that retro-reflects can be related or defined by a "clocking angle," such as 12 o'clock or 6 o'clock perpendicular to the optical axis. Using this information, we now turn to the Polushkin reference.

Polushkin appears to describe laser rod systems where the end faces have polished facets of various numbers (2= Porro prism, 3=cornercube, etc.) polished directly onto the rod to act as end reflectors and make the laser rugged to misalignment of the ends. In Polushkin's description, they only address issues of end reflectors and alignment there is no discussion of thermal compensation. These faceted designs are used specifically as retro-reflectors. They preserve the angle of reflection to be exactly 180 degrees of the incident light. The vertex angles are 90 degrees and there is no margin here, meaning that the angles have to be 90 degrees. Any fabrication off 90 degrees induces misalignment and there is performance degradation. Furthermore, there is no specificity of the orientation of the roof angle azimuth or "clocking angle" of the Porro prism. In their scheme, this angle is not important.

However, as one skilled in the art would know based on Applicants' disclosure, in terms of thermal compensation, the clocking angle is important. In an exemplary embodiment, a new and inventive idea is the use of a specific tilt, depending on the thermal load and material properties, to compensate specifically for induced tilt of the wave front caused by thermal aberration as the wave front propagates through the crystal of the laser. See, e.g., paragraphs 0049-0051 and 0054 of the present disclosure. This thermal compensation is not performed by the retro-reflectors in the scheme in Polushkin because, e.g., the wave front is not inverted on reflection in Polushkin. Polishing a retro-reflector onto the end of a rod with faceted knife edges to correct for end misalignment, is not equivalent to purposefully "misaligning" a laser's end face (or both faces) so the thermally induced wave front tilt is properly compensated for during a round trip in the resonator when the laser is

operating and under thermal load, as what would occur in dependent claim 29 for instance. In an exemplary embodiment herein, only in the case of the Porro prism is there any wave front reversal and inversion and only if the Porro clocking angle is correct for single sided pumping. If the clocking angle is off, there is no thermal compensation.

Further, the examiner states on page 6, third paragraph of the outstanding Office Action that "Polushkin appears to allow for a wide variety of shapes." As described above, the crux of Polushkin's patent is to avoid tilt misalignment of end mirrors by using retro-reflectors. In Applicants claims and specification, tilt misalignment is specifically being performed for thermal compensation. "A variety of shapes" does not constitute a purposeful misalignment of an end face, as in certain exemplary embodiments of the disclosed invention.

Consequently, Applicants respectfully submit that Polushkin does not teach, imply, or inherently contain any surface (including tilted surfaces, Porro prisms, or means for thermally induced aberration compensation) that is adapted for thermal aberration compensation, as recited generally in claims 11-13, 25-32, and 36.

Additionally, the Examiner is combining Ashby and Polushkin to reject claims 11-13, 25-32, and 36 (and 33, discussed below). It is not clear that the techniques of Polushkin could be used on the apparatus of Ashby. Ashby is a laser that is formed on a semiconductor substrate. Ashby does state that "[t]he end-facet mirrors 16 and 18 are then formed on the solid-state laser by cleaving the semiconductor wafer." Col. 6, lines 9-10. Examining FIG. 2 of Ashby, though, one can see that the lasing medium 14 is on a substrate 20. How would one form the structures of Polushkin on a lasing medium 14 that is on a substrate 20? Polushkin deals with rods and there is no teaching or implication that the techniques are applicable to lasers formed on semiconductors, as in Ashby.

Therefore, Applicants respectfully submit that there is no motivation to combine Ashby and Polushkin.

Applicants respectfully submit that Polushkin, Ashby, or their combination does not teach, imply, or inherently contain any surface that is adapted for thermal aberration compensation, and submit that the combination of Ashby and Polushkin is improper. Thus, claims 11-13, 25-32, and 36 are patentable over the combination of Ashby and Polushkin.

Rejection of claim 33 under 35 U.S.C. § 103(a) in part (6)

Because independent claim 25 is patentable, claim 33 is also patentable for at least the reasons given with regard to claim 25.

Conclusion

Based on the foregoing arguments, it should be apparent that claims 1-13, 25-34, and 36-38 are thus allowable over the reference(s) cited by the Examiner, and the Examiner is respectfully requested to reconsider and remove the rejections.

Respectfully submitted:

Robert J. Mauri
Reg. No.: 41,180

8/29/05
Date

Customer No.: 29683

HARRINGTON & SMITH, LLP
4 Research Drive
Shelton, CT 06484-6212

Telephone: (203)925-9400
Facsimile: (203)944-0245
email: rmauri@hspatent.com

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. BOX 1450, Alexandria, VA 22313-1450.

Elaine F. Mion
Name of Person Making Deposit

8/29/2005
Date